NONRESIDENTIAL ACM MANUAL APPENDIX NI

Appendix NI - Alternate Default Fenestration Thermal Properties

Scope

This appendix applies to fenestration excepted from Section 116 (a) 2 and Section 116 (a) 3 of the Standard.

> "***EXCEPTION to Section 116 (a) 2****: If the fenestration product is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration or is a skylight, the default U-factor may be the applicable U-factor as set forth in the Nonresidential ACM Manual.*"
>
> "***EXCEPTION to Section 116 (a) 3:*** *If the fenestration product is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration or is a skylight, the default SHGC may be calculated according to Equation 116-A.*"

Purpose

To present alternate default U-factors and the calculation method for determining an alternate default SHGC, and to describe the responsibilities of energy consultants, designers, architects, builders, installers, and building departments when an alternate default value is used for determining compliance.

NI.1 Solar Heat Gain Coefficient

This section describes the alternative calculation method for determining compliance for eligible site-built products. The following equation may be used to calculate the fenestration product's SHGC used to determine compliance. Convert the center of glass SHGC, $SHGC_c$, from the manufacturer's documentation to a value for the fenestration product with framing, $SHGC_{fen,}$

$$\mathbf{SHGC_{fen} = 0.08 + 0.86 \times SHGC_c}$$

Where:

$SHGC_{fen}$ is the SHGC for the fenestration including glass and frame.

$SHGC_c$ is the SHGC for the center of glass alone, and

NI.1.2 Responsibilities for SHGC Compliance

This section describes the responsibilities of energy consultants, designers, architects, builders, installers, and building departments when this alternative calculation method is used for determining compliance with SHGC requirements.

NI.1.2.1 Energy Consultants, Designers, Architects

Site-Built Fenestration Products without SHGC Rated Using NFRC Procedures

The procedure described below applies only to skylights and to site-built fenestration in buildings with less than 10,000 ft^2 of site-built fenestration.

To determine compliance with the efficiency standards, the center of glass SHGC from the manufacturer's documentation for the proposed glazing must be converted to an $SHGC_{fen}$ for the fenestration that includes the framing effect.

For the Prescriptive compliance method, the $SHGC_{fen}$ is then entered into the prescriptive ENV-1 form, Part 2 of 2 and must appear on the building plans.

For the Performance compliance method, the $SHGC_{fen}$ output information printed on the Performance ENV-1 form must be listed on the building plans. The PERF-1 and Performance ENV-1 forms must appear on the plans. The building plan window schedule list must indicate the proposed total $SHGC_{fen}$ values for each fenestration assembly, and these values must be equal to the SHGCs listed on the Performance ENV-1 computer form. (Note: an under-calculation of space conditioning energy can result from entering either too low or too high an $SHGC_{fen}$ for the product.)

Permit applications must include heat gain documentation for the Building Plan Checker. This documentation must include a copy of the manufacturer's documentation showing the $SHGC_c$, center of glass alone and the calculation used to determine the $SHGC_{fen}$. If the proposed design uses multiple fenestration products or site-assembled fenestration products, a calculation for each different $SHGC_{fen}$ must be attached to the plans along with each glass unit manufacturer's documentation.

Building plans shall identify all site-built fenestration and all site-built fenestration without SHGCs rated using NFRC procedures.

Mixed Fenestration Types

If mixed fenestration is included in the compliance analysis, then the compliance submittal must demonstrate which are certified fenestration products and which are non-certified fenestration or site-built fenestration products. The manufacturer's documentation and calculations for each product must be included in the submittal, and either the ENV-1 or PERF-1 form must be included on the building plans.

NI.1.2.2 Builder and Installer Responsibilities

The builder is responsible for ensuring that the glass documentation showing the SHGC used for determining compliance is provided to the installer. The builder is responsible for obtaining an NFRC Label Certificate for Site-Built Products for the building's site-built fenestration if the building has 10,000 ft^2 or more of site-built fenestration.

The builder is also responsible for ensuring that the persons preparing compliance documentation are specifying products that the builder intends to install. The builder must ensure that the glazing contractor installs the glass with the same $SHGC_c$ as used for compliance and that the building inspector is provided with manufacturers' documentation showing the $SHGC_c$ for the actual glass product installed. The builder should verify that these fenestration products are clearly shown on the building plans before fenestration products are purchased and installed.

NI.1.2.3 Building Department Responsibilities

Plan Checker

The building department plan checker is responsible for ensuring that the plans identify all site-built fenestration.

The plan-checker is responsible for verifying that for skylights and site-built fenestration using the alternate default SHGC calculation:

1. the $SHGC_{fen}$ and $SHGC_c$ are identified on the plans,
2. calculations have been provided showing the conversion from $SHGC_c$ to $SHGC_{fen}$,
3. manufacturer documentation of the $SHGC_c$ has been provided for each of the fenestration products using alternate default SHGC calculations, and

4. the building has less than 10,000 ft^2 of site-built fenestration.

Plans should be consistent with the compliance documentation, the calculations showing the conversion from $SHGC_c$ to $SHGC_{fen}$, and Prescriptive ENV-1 Part 2 of 2 or Performance ENV-1.

Building Inspector

The building department field inspector is responsible for ensuring that the building using an alternate default SHGC calculation has less than 10,000 ft^2 of site-built fenestration.

The field inspector is responsible for ensuring that the $SHGC_c$ and $SHGC_{fen}$ for the installed fenestration is consistent with the plans, the Prescriptive ENV-1 Part 2 of 2 or the Performance PERF-1 and Performance ENV-1, and that manufacturer documentation is consistent with the product installed in the building.

NI.2 Thermal Transmittance (U-Factor)

Table NI-1 provides default U-factors for skylights and for site-built fenestration in buildings with less than 10,000 ft^2 of site-built fenestration.

The default Table NI-1 is consistent with default U-factors published in Table 4, Chapter 30, ASHRAE Fundamentals Handbook, 2001, which is referenced in the Energy Standards. Fenestration products fitting the two descriptions above may still use U-factors obtained through NFRC if available.

NI.2.1 Responsibilities for U-factor Compliance

This section describes the responsibilities of energy consultants, designers, architects, builders, installers, and building departments when Table NI-1 is used for determining compliance with the U-factor requirements of the Efficiency Standards.

NI.2.1.1 Energy Consultants, Designers, Architects

Site-Built Fenestration without U-factor Rated Using NFRC Procedures

The procedure described below applies only to skylights and to site-built fenestration in buildings with less than 10,000 ft^2 of site-built fenestration. To determine compliance with the efficiency standards, the Glazing Type and Frame Type shown in Table NI-1 must be identified from the manufacturer's documentation for the proposed glazing.

For the Prescriptive compliance method, the U-factor must be selected from Table NI-1 for this Glazing Type and Frame Type and entered into the prescriptive ENV-1 form, Part 2 of 2, and must appear on the building plans.

For the Performance compliance method, the U-factor output information printed on the Performance ENV-1 form must be listed on the building plans. The PERF-1 and Performance ENV-1 forms must appear on the plans. The building plan window schedule list must indicate the proposed total U-factors for each fenestration assembly, and these values must be equal to or less than the U-factors listed on the Performance ENV-1 computer form.

Permit applications must include fenestration U-factor documentation for the Building Plan Checker. This documentation must include a copy of the manufacturer's documentation showing the Glazing Type information – number of panes, spacing of panes, glass type, gas fill type, coating emissivity and location – and the Frame Type – frame material type, presence of thermal breaks, and identification of structural glazing (glazing with no frame) that is used to determine the U-factor. If the proposed design uses multiple fenestration products or site-assembled fenestration products, manufacturer's documentation for each different U-factor for each glass unit must be attached to the plans. Manufacturer's documentation must be provided for each U-factor used for compliance.

Building plans shall identify all site-built fenestration and all site-built fenestration without U-factors rated using NFRC procedures.

Mixed Fenestration Types

If mixed fenestration is included in the compliance analysis, then the compliance submittal must demonstrate which are certified fenestration products and which are non-certified fenestration or site-assembled fenestration products. The manufacturer's documentation and calculations for each product must be included in the submittal, and either the ENV-1 or PERF-1 form must be included on the building plans.

NI.2.1.2 Builder and Installer Responsibilities

The builder is responsible for ensuring that the glass documentation showing the U-factor used for determining compliance is provided to the installer. The builder is responsible for ensuring that the persons preparing compliance documentation are specifying products that the builder intends to install. The builder is also responsible for ensuring that the installer installs glass with U-factors the same or lower than the U-factors used for compliance and ensuring that the field inspector for the building department is provided with manufacturer's documentation showing the U-factor and method of determining U-factor for the actual fenestration product installed. The builder should verify that these fenestration products are clearly shown on the building plans before fenestration products are purchased and installed.

NI.2.1.3 Building Department Responsibilities

Plan Checker

The building department plan checker is responsible for ensuring that the plans identify all site-built fenestration.

The plan checker shall ensure that for skylights and site-built fenestration using alternate default U-factors:

1. U-factors are identified on the plans,
2. the Glazing Type and Frame Type and Table NI-1 have been provided documenting the method of determining the U-factor,
3. manufacturer documentation of the Glazing Type and Frame Type has been provided for the each of the fenestration products using alternate default U-factors, and
4. the building has less than 10,000 ft^2 of site-built fenestration.

Plans should be consistent with the compliance documentation, the Glazing Type and Frame Type and Table NI-1 values, and Prescriptive ENV-1 Part 2 of 2 or Performance ENV-1.

Building Inspector

The building department field inspector is responsible for ensuring that the building using an alternate default U-factor has less than 10,000 ft^2 of site-built fenestration.

The building department field inspector is responsible for ensuring that manufacturer's documentation has been provided for the installed fenestration. The field inspector is responsible for ensuring that the U-factor for the installed fenestration is consistent with the plans, the Prescriptive ENV-1 Part 2 of 2 or the Performance PERF-1, and Performance ENV-1, and that manufacturer documentation is consistent with the product installed in the building.

Table NI-1 – Alternate U-Factors for Skylights and Eligible[1] Site-Built Fenestration

Product Type		Vertical Installation				Sloped Installation						
		Unlabeled Glazed Wall Systems (Site Built Windows) (includes site assembled fixed windows only, does not include operable windows)				**Unlabeled Skylight with Curb** (includes glass/plastic, flat/domed, fixed/operable)				**Unlabeled Skylight without Curb** (includes glass/plastic, flat/domed, fixed/operable)		
Frame Type		Aluminum without Thermal Break	Aluminum with Thermal Break	Wood/Vinyl	Structural Glazing	Aluminum without Thermal Break	Aluminum with Thermal Break	Reinforced Vinyl/ Aluminum Clad Wood	Wood/Vinyl	Aluminum without Thermal Break	Aluminum with Thermal Break	Structural Glazing
ID	**Glazing Type**											
	Single Glazing											
1	1/8" glass	1.22	1.11	0.98	1.11	1.98	1.89	1.75	1.47	1.36	1.25	1.25
2	1/4" acrylic/polycarb	1.08	0.96	0.84	0.96	1.82	1.73	1.60	1.31	1.21	1.10	1.10
3	1/8" acrylic/polycarb	1.15	1.04	0.91	1.04	1.90	1.81	1.68	1.39	1.29	1.18	1.18
	Double Glazing											
4	1/4" airspace	0.79	0.68	0.56	0.63	1.31	1.11	1.05	0.84	0.82	0.70	0.66
5	1/2" airspace	0.73	0.62	0.50	0.57	1.30	1.10	1.04	0.84	0.81	0.69	0.65
6	1/4" argon space	0.75	0.64	0.52	0.60	1.27	1.07	1.00	0.80	0.77	0.66	0.62
7	1/2" argon space	0.70	0.59	0.48	0.55	1.27	1.07	1.00	0.80	0.77	0.66	0.62
	Double Glazing, *e*=0.60 on surface 2 or 3											
8	1/4" airspace	0.76	0.65	0.53	0.61	1.27	1.08	1.01	0.81	0.78	0.67	0.63
9	1/2" airspace	0.69	0.58	0.47	0.54	1.27	1.07	1.00	0.80	0.77	0.66	0.62
10	1/4" argon space	0.72	0.61	0.49	0.56	1.23	1.03	0.97	0.76	0.74	0.63	0.58
11	1/2" argon space	0.67	0.56	0.44	0.51	1.23	1.03	0.97	0.76	0.74	0.63	0.58
	Double Glazing, *e*=0.40 on surface 2 or 3											
12	1/4" airspace	0.74	0.63	0.51	0.58	1.25	1.05	0.99	0.78	0.76	0.64	0.60
13	1/2" airspace	0.66	0.55	0.44	0.51	1.24	1.04	0.98	0.77	0.75	0.64	0.59
14	1/4" argon space	0.69	0.57	0.46	0.53	1.18	0.99	0.92	0.72	0.70	0.58	0.54
15	1/2" argon space	0.63	0.51	0.40	0.47	1.20	1.00	0.94	0.74	0.71	0.60	0.56
	Double Glazing, *e*=0.20 on surface 2 or 3											
16	1/4" airspace	0.70	0.59	0.48	0.55	1.20	1.00	0.94	0.74	0.71	0.60	0.56
17	1/2" airspace	0.62	0.51	0.39	0.46	1.20	1.00	0.94	0.74	0.71	0.60	0.56
18	1/4" argon space	0.64	0.53	0.42	0.49	1.14	0.94	0.88	0.68	0.65	0.54	0.50
19	1/2" argon space	0.57	0.46	0.35	0.42	1.15	0.95	0.89	0.68	0.66	0.55	0.51
	Double Glazing, *e*=0.10 on surface 2 or 3											
20	1/4" airspace	0.68	0.57	0.45	0.52	1.18	0.99	0.92	0.72	0.70	0.58	0.54

Product Type		Vertical Installation				Sloped Installation						
		Unlabeled Glazed Wall Systems (Site Built Windows) (includes site assembled fixed windows only, does not include operable windows)				**Unlabeled Skylight with Curb** (includes glass/plastic, flat/domed, fixed/operable)				**Unlabeled Skylight without Curb** (includes glass/plastic, flat/domed, fixed/operable)		
Frame Type		Aluminum without Thermal Break	Aluminum with Thermal Break	Wood/Vinyl	Structural Glazing	Aluminum without Thermal Break	Aluminum with Thermal Break	Reinforced Vinyl/ Aluminum Clad Wood	Wood/Vinyl	Aluminum without Thermal Break	Aluminum with Thermal Break	Structural Glazing
21	1/2" airspace	0.59	0.48	0.37	0.44	1.18	0.99	0.92	0.72	0.70	0.58	0.54
22	1/4" argon space	0.62	0.51	0.39	0.46	1.11	0.91	0.85	0.65	0.63	0.52	0.47
23	1/2" argon space	0.55	0.44	0.33	0.39	1.13	0.93	0.87	0.67	0.65	0.53	0.49
	Double Glazing, *e*=0.05 on surface 2 or 3											
24	1/4" airspace	0.67	0.56	0.44	0.51	1.17	0.97	0.91	0.70	0.68	0.57	0.52
25	1/2" airspace	0.57	0.46	0.35	0.42	1.17	0.98	0.91	0.71	0.69	0.58	0.53
26	1/4" argon space	0.60	0.49	0.38	0.44	1.09	0.89	0.83	0.63	0.61	0.50	0.45
27	1/2" argon space	0.53	0.42	0.31	0.38	1.11	0.91	0.85	0.65	0.63	0.52	0.47
	Triple Glazing											
28	1/4" airspaces	0.63	0.52	0.41	0.47	1.12	0.89	0.84	0.64	0.64	0.53	0.48
29	1/2" airspaces	0.57	0.46	0.35	0.41	1.10	0.87	0.81	0.61	0.62	0.51	0.45
30	1/4" argon spaces	0.60	0.49	0.38	0.43	1.09	0.86	0.80	0.60	0.61	0.50	0.44
31	1/2" argon spaces	0.55	0.45	0.34	0.39	1.07	0.84	0.79	0.59	0.59	0.48	0.42
	Triple Glazing, *e*=0.20 on surface 2,3,4, or 5											
32	1/4" airspaces	0.59	0.48	0.37	0.42	1.08	0.85	0.79	0.59	0.60	0.49	0.43
33	1/2" airspaces	0.52	0.41	0.30	0.35	1.05	0.82	0.77	0.57	0.57	0.46	0.41
34	1/4" argon spaces	0.54	0.44	0.33	0.38	1.02	0.79	0.74	0.54	0.55	0.44	0.38
35	1/2" argon spaces	0.49	0.38	0.28	0.33	1.01	0.78	0.73	0.53	0.54	0.43	0.37
	Triple Glazing, *e*=0.20 on surfaces 2 or 3 and 4 or 5											
36	1/4" airspaces	0.55	0.45	0.34	0.39	1.03	0.80	0.75	0.55	0.56	0.45	0.39
37	1/2" airspaces	0.48	0.37	0.26	0.31	1.01	0.78	0.73	0.53	0.54	0.43	0.37
38	1/4" argon spaces	0.50	0.39	0.29	0.34	0.99	0.75	0.70	0.50	0.51	0.40	0.35
39	1/2" argon spaces	0.45	0.34	0.24	0.29	0.97	0.74	0.69	0.49	0.50	0.39	0.33
	Triple Glazing, *e*=0.10 on surfaces 2 or 3 and 4 or 5											
40	1/4" airspaces	0.54	0.43	0.32	0.37	1.01	0.78	0.73	0.53	0.54	0.43	0.37
41	1/2" airspaces	0.46	0.35	0.25	0.29	0.99	0.76	0.71	0.51	0.52	0.41	0.36
42	1/4" argon spaces	0.48	0.38	0.27	0.32	0.96	0.73	0.68	0.48	0.49	0.38	0.32
43	1/2" argon spaces	0.42	0.32	0.21	0.26	0.95	0.72	0.67	0.47	0.48	0.37	0.31
	Quadruple Glazing, *e*=0.10 on surfaces 2 or 3 and 4 or 5											

Product Type		**Vertical Installation**				**Sloped Installation**						
		Unlabeled Glazed Wall Systems (Site Built Windows) (includes site assembled fixed windows only, does not include operable windows)				**Unlabeled Skylight with Curb** (includes glass/plastic, flat/domed, fixed/operable)				**Unlabeled Skylight without Curb** (includes glass/plastic, flat/domed, fixed/operable)		
Frame Type		Aluminum without Thermal Break	Aluminum with Thermal Break	Wood/Vinyl	Structural Glazing	Aluminum without Thermal Break	Aluminum with Thermal Break	Reinforced Vinyl/ Aluminum Clad Wood	Wood/Vinyl	Aluminum without Thermal Break	Aluminum with Thermal Break	Structural Glazing
44	1/4" airspaces	0.49	0.38	0.28	0.33	0.97	0.74	0.69	0.49	0.50	0.39	0.33
45	1/2" airspaces	0.43	0.32	0.22	0.27	0.94	0.71	0.66	0.46	0.47	0.36	0.30
46	1/4" argon spaces	0.45	0.34	0.24	0.29	0.93	0.70	0.65	0.45	0.46	0.35	0.30
47	1/2" argon spaces	0.41	0.30	0.20	0.24	0.91	0.68	0.63	0.43	0.44	0.33	0.28
48	1/4" krypton spaces	0.41	0.30	0.20	0.24	0.88	0.65	0.60	0.40	0.42	0.31	0.25